SCAN ALIGNMENT BASED ON PATIENT-BASED SURFACE IN MEDICAL DIAGNOSTIC ULTRASOUND IMAGING

BACKGROUND

[0001] The present embodiments relate to medical diagnostic imaging. Medical images are stored in various coordinate systems, often relative to the scanner or some arbitrary point in space. This makes it difficult to align and compare scans taken at different times, scanners, modalities and patients, e.g. to relate follow-up studies of the same patient or to quantitatively compare scans across patient populations. For example, ultrasound images representing planar slices of a patient are stacked using freehand ultrasound scanning to provide a three-dimensional (3D) representation of the patient. The pose of the transducer or image plane then allows assembling the individual two-dimensional (2D) ultrasound slices into a 3D volume. Understanding the image information in a 3D spatial context may be highly desirable. When such scanning is repeated for the same patient at a later examination, the pose information for the later scan is not related to the pose of the pervious scan. The coordinate systems from the different scans need to be aligned to allow comparison of the images and/or information from the images. In a thyroid examination example, a sonographer may spend an hour trying to identify corresponding lesions in the later examination that were previously located for the earlier examination.

[0002] Alignment of medical images is often done manually or by visual comparison next to each other. Manual alignment may not be accurate and may vary widely between users, making the images less diagnostically reliable. Depending on the use case, there are image-based registration methods to automatically align scans (e.g., registration of follow-up scans to prior scans of the same patient, or registration of scans for different modalities (e.g. CT and PET imaging)). Image-based registration may be computationally expensive and requires large storage to store the entire three-dimensional scan for later registration.

SUMMARY

[0003] By way of introduction, the preferred embodiments described below include methods, computer-readable media, and systems for aligning scans from different times with a medical imager. Imaging from sequential scans is aligned based on patient information. A three-dimensional distribution of a patient-related object or objects, such as an outer surface of the patient or an organ in the patient, is stored with any results (e.g., images and/or measurements). Rather than the entire scan volume, the three-dimensional distributions from the different scans are used to align between the scans. The alignment allows diagnostically useful comparison between the scans, such as guiding an imaging technician to more rapidly determine the location of a same lesion for size comparison.

[0004] In a first aspect, a method is provided for aligning scans from different times with a medical imager. A patient is scanned at a first time. The scanning resulting in first scan data representing the patient at the first time. The medical imager scans the patient at a second time. The scanning results in second scan data representing the patient at the second time. The second time is for a different imaging session than the first time. A first surface in three-dimensions is generated and represents the patient at the first time. A second surface in three-dimensions is generated and represents the patient at the second time. A spatial transformation between the first surface and the second surface is determined. First information from the first scan data is compared with second information from the second scan data based on the spatial transformation. An image of the first and second information is displayed.

[0005] In a second aspect, a method is provided for aligning scans from different times with a medical ultrasound imager. The medical ultrasound imager three-dimensionally scans with a free-hand transducer a volume of a patient during a first appointment. A three-dimensional distribution represented by scan data from the three-dimensionally scanning during the first appointment and one or more lesions represented by the scan data are determined. A two-dimensional image for the one or more lesions, the three-dimensional distribution, and a location or locations for the one or more lesions are stored. The volume of the patient is three-dimensionally scanned during a second appointment different than the first appointment. The three-dimensional distribution is registered with results from the scanning of the volume during the second appointment. Imaging from the scanning during the second appointment is guided by the registering to be for the one or more lesions.

[0006] In a third aspect, a method is provided for aligning scans from different times with a medical imager. A patient is scanned during a first period. A three-dimensional outside surface of the patient during the scanning of the first period is determined, e.g. with a camera that includes a depth sensor. The patient is scanned during a second period at least a day apart from the first period. A three-dimensional outside surface of the patient during the scanning of the second period is determined. The three-dimensional outside surface of the patient from the first period is registered with the three-dimensional outside surface of the patient from the second period. An image from the scanning the patient during the second period is generated based on the registering.

[0007] The present invention is defined by the following claims, and nothing in this section should be taken as a limitation on those claims. Further aspects and advantages of the invention are discussed below in conjunction with the preferred embodiments and may be later claimed independently or in combination.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The components and the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views.

[0009] FIG. **1** is a flow chart diagram of an embodiment of a method for aligning scans from different times with a medical imager;

[0010] FIG. **2** shows an example alignment of coordinates from scans at different times where the alignment is based on patient-specific models;

[0011] FIG. **3** is a block diagram of one embodiment of a medical imager system for aligning scans from different times.